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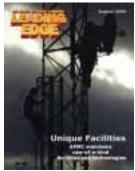
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#### **Cover Stories**



Tinker Air Force Base, Okla., tests all B-52 radomes. Periodic maintenance requires climbing a two-story antenna, which sends signals to walting radomes. Original photo by Ms. Margo Wright, graphic design by 1st Lt. CK Keegan.

### 4 - 17 Unique facilities

fter World War II, scientists investigating German military and industrial facilities realized the rest of the world was years behind in technology. This was unacceptable to leaders at the time, such as Henry "Hap" Arnold who determined the United States would never fall behind technologically again. Facilities, unique in the Air Force and in some cases, unique in the world were developed and continue to be developed today in AFMC. These unique facilities provide warfighters with the latest technology to do their jobs and are also in demand from other government and commercial agencies. This Leading Edge features many of these state-of-the-art facilities.

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#### **Back cover**

Mr. Jess Phillips, radome tester, wears gloves to keep his hands clean from hydralic fluid as he positions the B-52 nose radome before testing. Photo by Ms. Margo Wright. Layout by 1st Lt. CK Keegan.



#### **Mission Briefs**

#### RESEARCH AND DEVELOPMENT

#### Laser facility opens

KIRTLAND AIR FORCE BASE, N.M. – Several hundred people, including local, state, and congressional representatives, attended a ribboncutting ceremony here June 2 for a 29,600-square-foot, \$8.4 million advanced laser research facility.

This state-of-the-art facility will be used by the Air Force Research Laboratory Directed Energy Directorate for research and development of chemical, electrical and hybrid lasers.

A two-story structure, this facility has six major laboratories. Two of the major labs are dedicated to chemical laser research while the remaining four are for solid-state or electrical laser

Smaller laboratories devoted to chemistry and electronics are also included in the facility.

- Mr. Rich Garcia, AFRL Public Affairs

#### Ohio State University to maintain wind tunnels

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A cooperative research and development agreement was signed June 2 by Col. David Walker, director, Air Force Research Laboratory, or AFRL, Air Vehicles Directorate here, and Dr. James Ball, associate director, Ohio State University, or OSU, to transfer maintenance and operations for seven wind tunnels at Wright-Patterson from the Air Force to OSU.

"This step is the result of cutbacks in Air Force research funding," said Dr. Don Paul, chief scientist, Air Vehicles Directorate, which owns the wind tunnels. "It is expected to save the Air Force more than \$500,000 per year and create additional opportunities for major collaboration between OSU and AFRL."

"This agreement also will open our facilities to other universities, as well as non-military, commercial industries across the United States that need to do aerodynamic research to improve existing products, or develop new ones," Dr. Paul said.

Dr. Gerald Gregorek, professor of aerospace engineering and director of the Aeronautical and Astronautical Research Laboratory, led the OSU effort to work out agreement details and will direct the transition program.

In addition to the main players, the partnership — facilitated by the Wright Technology Network, which promotes AFRL technology transfer activities — will involve a variety of participants, including the Dayton Area Graduate

Studies Institute, industry members such as Boeing and Honda, and other government agencies such as the U.S. Army, Dr. Paul said.

"This agreement greatly benefits OSU, the Air Force and their future research partners, while conserving precious historical, economic and technical resources," Dr. Paul said.

— Ms. Sue Baker, ASC Public Affairs

## Raptor 4004 completes initial radar testing

MARIETTA, Ga. — Raptor 4004, the first F-22 to test the aircraft's integrated avionics suite, successfully completed it's initial radar cross section verification testing June 13 at Lockheed Martin's verification facility here.

During the tests, sensors measured the Raptor's radar signature from various angles as it rotated while attached to the facility's 45-foot diameter turntable. The F-22 is the first aircraft development program to establish a repeatable, reliable and verifiable RCS test capability using ground-based facilities.

Once Raptor 4004 enters the Air Force flight test program later this year, the aircraft will undergo additional RCS testing while in flight.

— Mr. Greg Caires, Lockheed Martin

#### **TEST AND EVALUATION**

#### F-22 Raptor flight testing resumes at Edwards

EDWARDS AIR FORCE BASE, Calif. — Flight testing for Aircraft 4002, one of two F-22 Raptors here, has resumed June 5 following a nearly fourweek delay because of minute cracks found in the jets' canopies.

The hairline surface cracks, which were less than an inch long, were discovered in a lower area where 140 bolts attach a 190-pound transparency to the canopy frame, and aren't visible from the cockpit.

Safety concerns over possible bird strikes during low-level, high-speed test sorties was the main reason for

temporarily delaying flight tests of the fighter, said Col. C.D. Moore, director, F-22 Combined Test Force.

An F-22 tiger team has determined an existing canopy has sufficient residual strength for continued flight tests "as is,"



following an intensive investigation into the canopy cracking phenomenon, according to F-22 program officials. While testing with this canopy, 4002 will be operating under restrictions to minimize the risk of a catastrophic bird strike, but this limitation has no effect on the completion of required testing.

Additional new canopies are being fabricated for the remaining test aircraft.

Col. Moore said that cracking isn't an unusual aircraft development issue; that this has happened before during flight testing for other

weapon systems, and affirmed that the cracking will not impact the F-22's ability to deliver established test objectives by year's end.

- Mr. Ray Johnson, AFFTC Public Affairs

## Brooks lab key to solving puzzles

n a one-of-a-kind Air Force facility, analysts sift through remnants of things that to untrained eyes appear to be an unsolvable jigsaw puzzle.

Holding part of a boot heel in one hand and cradling in his other hand a faded and tattered portion of a flight suit harness, Mr. Alex Villalva echoes the feelings of fellow equipment analysts working at the Life Sciences Equipment Laboratory, Brooks Air Force Base, Texas.

#### **Answering questions**

"I'm holding what the individual service member was likely wearing during his last moments on earth. Our feelings are tempered by the fact that we are providing answers to families of loved ones' final whereabouts," he said.

Since 1993, this lab has partnered with the Joint Task Force-Full Accounting, or JTF-FA, in helping resolve old missing in action cases from the Vietnam War. Before its expanded role supporting JTF-FA, this former Kelly Air Force Base, Texas, lab has been investigating life support equipment issues associated with Air Force mishaps since its inception in 1983.

Today, the 311th Human Systems Program Office lab is housed in a new, specially built 20,700-square-foot, state-of-the-art facility. It is equipped with the latest forensic science

tools, a comprehensive reference library detailing specifications on military equipment and clothing, and a huge collection of complete artifact specimens used in comparative analysis.

"We don't deal with human remains," said Mr. John Goines III, the lab's chief who is also a senior equipment analyst. The lab leaves human remains investigations and DNA testing to the U.S. Army Central Identification Lab, or CILHI, in Hawaii and the Armed Forces DNA Identification Laboratory in Maryland. The Brooks lab primarily focuses on analyzing equipment artifacts collected by JTF-FA teams in Southeast Asia.

#### **Searching for clues**

Clues revealing the fate of MIAs can be gleaned from such "time capsules" as parachute fragments, flight suit zippers, boot eyelets, and parts from locator beacons, helmets and ejection seats.

No shred of material evidence is too small to be scrutinized. Special microscopes and other forensic devices that can penetrate the shroud of time-faded images have helped yield valuable information needed in resolving cases.

Mr. Goines' team works on the most difficult cases where there are little or no human remains for forensic pathologists and anthropologists to use in identification.

"We're essentially the last hope for full extensive analysis of these cases," he said.

Once these analysts make a determination based on the evidence, they pass their recommendations on to JTF-FA headquartered in Hawaii. JTF-FA and CILHI are jointly responsible for bringing final closure for MIA families by accounting for those who were killed in action or listed as missing.

To get to that point, lab sleuths work with circumstantial evidence. This ranges from investigating personal effects such as keys, credit cards and wallets to non-issue items including cowboy boots and borrowed military equipment.

"We're looking at everything that an individual could carry,"



Above: Comparative analysis using a complete specimen found at Vietnam crash sites is a valuable tool in identifying MIAs. Left: Mr. Alex Villalva, equipment analyst, compares a piece of the flight suit harness from a former MIA pilot with a specimen from that era. Photos by Mr. Rudy Purificato, HSW



The pilot of this Navy A-4 who took off from the U.S.S. Coral Sea on June 25, 1965 was missing in action until analysts at the Life Sciences Equipment Lab positively identified part of his flight suit. The pilot's body has never been found.

he said.

Along with the boxes of artifacts shipped to the lab, analysts also study the MIA's biography file that includes a physical description of the individual. Other information such as eyewitness statements from unit members or Vietnamese villagers included in the profile sometimes provide investigators with good leads. The lab is set up to investigate cases involving all branches of America's armed forces as well as several allied nations. They are equipped to analyze cases ranging from World War II through Desert Storm.

#### **Expanded mission**

"Our mission expanded in 1998. The Secretary of the Air Force approved our lab supporting full accountability case studies from the Korean War," Mr. Goines said.

While these analysts rely on physical evidence, seldom do they find any genetic material, such as blood, discovered on artifacts they are investigating. "After 35 years in the jungle, bones are usually pulverized," said Mr. Gregory Buchrle, a retired U.S. Navy parachute rigger who is a lab analyst investigating Marine Corps and Navy equipment unearthed in Southeast Asia.

#### **Conflicting clues**

Most cases involve analyzing hundreds of artifacts that contain conflicting clues. Investigations here can last from six months to two years. "Usually when we're dealing with a case involving a jet, there's a high degree of fragmentation due to the high-speed impact," Mr. Villalva said.

The analysts' goal is to determine from the physical

evidence whether the aircrew member successfully ejected or crashed with the aircraft. The presence of life support artifacts can determine whether the service member was in the aircraft at the time of impact.

Mr. Villalva explained that determining "dynamic loading," the amount of energy applied to an artifact, can help reveal whether the service member had survived. He said if dynamic loading exceeded the parameters of an equipment item such as a harness, resulting in a shredded artifact, it's a strong indication the individual did not survive.

Greatly aiding analysts is the Life Sciences Artifact Section's historian, Dr. Bob Browning. The section features a comprehensive technical library and large collection of equipment reference exhibits. This material is used in conparative analysis, a key investigative technique. Investigators try to match artifact pieces with exhibit specimens, he said.

"This is the only lab in the United States that does this kind of work, and possibly is the only lab of it's kind in the world. The Israelis are considering establishing a lab similar to ours," Dr. Browning said.

Besides investigating MIA cases, the lab fulfills three other missions. These include: assisting aircraft mishap investigation boards; technical training United States military, federal and allied nations' personnel in life sciences equipment investigating techniques; and scientific upkeep of all Air Force life support equipment.

- Mr. Rudy Purificato, 311th HSW Public Affairs

## Tinker provides air for pilots to breathe

Tinker's oxygen and accessory support equipment repair shop provides the small components that provide the very air the pilots breathe. Tinker's Oxygen Shop supports pilots and aircrews by repairing oxygen regulators, converters and accessory equipment. The shop also inspects and repairs Tinker's Navy regulators.

#### The air they breathe

These life-support items make it possible for pilots and aircrew to breathe at the higher altitudes and are handled in a temperature-controlled environment. Machines from 1953, that are still considered state-of-the-art, are running side-by-side with new technology to maintain a workload of approximately 600 regulators a month, with each regulator taking from three to 13 hours each to tear down, clean, repair, replace and rebuild. At the same time, the shop is receiving a new workload.

"We're going to be inspecting and repairing the Pressure Breathing Gravity testing units used in the field to periodically test the aircrew regulators," said Mr. Mike Green, unit chief. "This is the future of oxygen equipment and this shop. Regulators in the field are routinely tested by the crew chief with the tester unit. When he finds a problem with a regulator, he sends the part to their supply for shipment to us. With 600 field testers in use, it'll be quite a bit of work for us."

Mr. Maurice Belding, an oxygen instrument mechanic and 38-year veteran of the shop, is one of the staff learning to run the tests on the field regulator testers. "This is something new and it's great to get new workloads in here," he said. "I've seen a lot of things during my career and this is really exciting — it's all new technology."

Each aircraft can have multiple regulators and converters serving from one to 100 people. For instance, the E-3 Sentry (AWACS) has 18 aircrew positions, 18 walk-around bottles and two different types of converters. The shop works on 10 different general categories of oxygen equipment having from 130 to 210 individual components each with 38 instrument mechanics.

#### **Increased workload**

"That's a lot of workload," said Mr. Green. "Because these components are considered life support, we don't just clean them and send them back. We make sure we tear it down, clean all parts, replace those we can and reassemble them. It's like a new product when it leaves here — the aircrew can have confidence in their life support."

Working with all the parts and being responsible for the air is a responsibility taken seriously by the staff of the shop.

"It's a challenging job," said Ms. Kimberly Stramski, instrument mechanic, as she worked on an F-16 combat edge regulator. "We do the best we can and we're into quality. I approach the work as if the person using the regulator I'm working on is a loved one. It makes me proud that someone is able to carry on the mission because of something I've done."

"The shop is becoming more involved with some of the new technology such as the Molecular Sieved Oxygen Generating System and the On-Board Oxygen Generating System, which are replacing the converters in some of the aircraft," said Mr. Green.

According to Mr. Green, these new processes have removed the hazards of liquid oxygen — fire and explosions. "The staff of the shop goes through extensive training on handling liquid





Top: Ms. Kimberly Stramski, an instrument worker in the oxygen and accessory support equipment repair shop, focuses on the small parts involved in tearing down an F-16 combat edge regulator. Bottom: oxygen and accessory support equipment repair shop instrument workers Mr. Maurice Belding, left, and Mr. Charles Derby learn their way through the repair process of a Pressure Breathing Gravity unit.

oxygen-related equipment. The liquid oxygen is highly combustible and any greases, hand creams, fingernail polish or lipstick can be dangerous.

In addition to regulators, the shop overhauls the converters, which act as storage units for the liquid oxygen until the aircrew turns on one of the regulators. "It will turn the liquid oxygen into a gas and warm it up so its breathable and then it's delivered to the regulators," said Mr. Green. "We completely overhaul all the converters used in the Air Force by replacing all of the valves, testing the new valves, inspecting all of the tubing and parts and then rebuilding the converter."

- Ms. Gail Kulhavy, OC-ALC Public Affairs

## Unique facilities can be "HERD"

n the panhandle of Florida, on the northwest corner of Eglin Air Force Base, is a unique High Explosive Research and Development facility known as the HERD.

As part of the Air Force Research Laboratory Munitions Directorate, the facility operates under the Ordnance Division's Energetic Materials Branch. This one-of-a- kind facility was established to provide the Air Force with modern in-house explosives research, development, test and evaluation capability, and quick reaction explosives loading.

The facility includes a properties laboratory; processing laboratory; explosives dynamics laboratory; reclamation and recycling laboratory; and the advanced energetics laboratory, as well as other explosives storage and test buildings.

"These five laboratories function as a single unit with the capability to operate within the complete spectrum of explosives research, development, test

and evaluation. Functions also include safety screening, mixing, loading, x-raying, dynamic evaluation, de-militarization and recovery of explosives, said Mr. Walt Maine, chief of the Ordnance Division.

The facility is distinctive within the Defense Department in that the five laboratories are co-located, said Dr. Robert McKenney, technical advisor of the Energetic Materials Branch.

"Experimental formulations meeting necessary chemical and physical criteria are mixed, machined and loaded in the processing laboratory. The detonation properties of these energetic materials are then determined in the dynamics laboratory," he said. Thus, an experimental formulation can be taken from small scale mixing and loading completely through the interim qualification stage.

'This takes place all at one location and at the site for development and testing of munition systems," said Dr. McKenney. Performance evaluation beyond the capability of the Dynamics Laboratory is carried out on the nearby Eglin test ranges.

— Mr. Rex Swenson, AAC publications

## Special or unique capabilities

- Pressing, melt cast processing and high-shear mixing of explosives.
- Consolidated facilities with convenient access to air/ground test sites provides flexibility to accomplish quick response projects.
- On-site explosive storage capacity in excess of 45,000 pounds makes this facility self-sufficient.
- All processes can be monitored and controlled remotely from a central control room using closed circuit television.

## Tunnel 9's 15 seconds make it unique

Tunnel 9, located at White Oak Md., has a runtime of 15 seconds, which doesn't seem very long compared to Arnold Engineering Development Center's, AEDC, Propulsion Wind Tunnel, which runs for days. But it's that quick runtime that makes Tunnel 9, an annex of AEDC, unique in the world.

Usually when a test requires high temperatures and pressures, a shock tunnel is selected.

"But, since shock tunnels rely on moving shocks and shocks move at the speed of sound, that leaves you with only a few thousandths of a second to run your test," said Mr. Dan Marren, project manager.

"The test article is put into a shock tunnel and air is blown over it," said Mr. Marren. "From that data, the engineer knows how the test article will perform at a certain orientation and speed."

Technicians move the test article to another orientation and another test is performed. This process continues until all of the data are gathered.

"In T9, which has up to a 15-second runtime, the test article can be pitched during the test," he said.

The test information gathered in one run normally takes a shock tunnel five to 15 runs. "Instead of two or three weeks of testing it only takes two or three days," he said.

The combination of high temperatures and pressures is another feature that makes T9 unique in the world.

"There are places that run for long times, there are places that get the high pressures, and there are places that get the high temperatures, but no one does it all together like we do at T9," Mr. Marren said.

"The type of pressure used at T9 is hard to imagine," he said. "If you took a large ship and tried to pull it out of the water suspended from a crane, there would be about 30,000 pounds per square inch on that hook. That is the type of pressure you are talking about at T9."

But what T9 also does is it uses temperatures up to 3,000 degrees Fahrenheit. It creates a challenge for the steel can that is trying to contain the gas.

"Steel is a strong metal," he said. "If it is thick enough, a steel can could contain 30,000 pounds per square inch of air, and it will be fine." Start adding heat and the steel starts to weaken and eventually ends up failing.

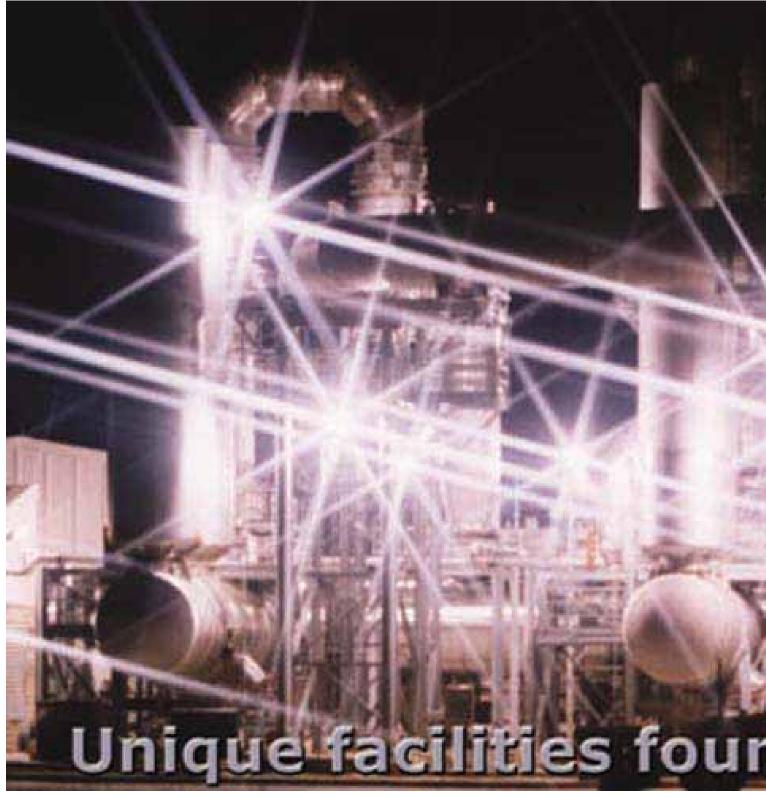
"At very high temperatures, the steel becomes something like Silly Putty. So, now you have Silly Putty trying to hold in 30,000 pounds of gas per square inch. It just doesn't work."

At T9, they protect the steel can from the temperature using multiple insulative layers. This technology is unique and is possible because of the expertise developed by the T9 mechanical engineering team.

It all comes down to risk. Without T9, a test article would run in a poorly simulated environment, and the engineers would be forced to make less informed decisions regarding which configuration to advance to the flight test program.

A flight test may cost the taxpayer \$50 million and take two years to plan. If the flight test fails, the whole process is repeated or the program cancelled with millions of dollars lost, said Mr. Marren.

"The environment we work in today, you fly and fail, your program's over," Marren said. "No one can afford to do that."



Development Center located at Arnold Air Force Base, Tenn., has a unique and vital Air Force mission.

Not only is Arnold's mission unique, but 27 of the center's 58 flight simulation test facilities are unique in the United States, and 14 are unique in the world.

Every high-performance flight system in use by the Air Force, Navy and Marines have been tested at Arnold, and has benefited by the center's unique test

facilities and highly skilled workforce.

#### **Test capabilities**

Arnold's test facilities simulate flight for models of aircraft, spacecraft, rockets and bombs in small and large wind tunnels that can simulate speeds up to Mach 18 (13,500 mph).

The center's jet engine test cells allow manufacturers to test jet engines under the full flight envelope from sea level to altitudes above 100,000 feet, at speeds up to Mach 3.5 (2,625 mph) and

under icing and other environmental conditions like saltwater spray.

The unique-in-the-world, highaltitude rocket test capability allows testing of actual rocket motors at high altitude.

Upper stage rocket motors for the Minuteman and Peacekeeper intercontinental ballistic missiles, the submarine launched Polaris, Poseidon and Trident missiles, as well as the Saturn V (for the Apollo Program), the Titan, the Atlas, and the next generation evolved expend-



able launch vehicles upper stage rocket motors, can only be tested under simulated high altitude flight conditions at Arnold.

The center's space chambers have tested full-scale Global Positioning Satellites and the shrouds that cover satellites on the tips of rockets to ensure they will open in space.

Coming up is commercial communications and weather satellites testing for Space Systems Loral in a 10-year, \$30 million contract (look for the Loral

story in September Leading Edge).

#### **Unique radiation**

Decade is the unique facility that will answer questions about how nuclear explosions in space effect U.S. defense systems.

The Decade facility tests communication, navigation, surveillance and tracking satellites as well as interceptor systems.

"Decade is a world class, one-of-a-kind, radiation environment simulation

facility that partially replaces the critical capability lost when underground nuclear testing was eliminated," said Mr. Ken Brandon, program manger. "Because we no longer conduct underground nuclear testing, the simulator partially replaces that capability in a safer, more cost effective way."

The Decade simulator produces the X-ray portion of a nuclear explosion within a highly shielded test cell during a test lasting approximately 40 nanosec—*Continued on page 14* 

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# Bad weather is a good thing

## Bringing bad weather is Eglin's climatic lab's job

The McKinley Climatic Laboratory at Eglin Air Force Base, Fla., opened in 1947. Its mission was to produce environmental extremes under controlled conditions to test military weapon systems.

Today, the 53-year-old lab continues that mission and has opened its doors to commercial companies across the planet. Whether it's blistering heat or sub-zero arctic temperatures, the climatic lab team can create it. But before the first snow flake falls or the last gust of wind blows, anyone interested in testing a piece of equipment must deal with Mr. Kirk Velasco.

#### Keeper of the storm

As director of the world-famous climatic lab, Mr. Velasco is responsible for the approximately 250,000 square foot facility, 37 lab employees and overseeing the day-to-day lab activities. Not only is he in charge of the world's largest environmental chamber, measuring in at 252-by-260-by-70 feet, he also has five additional smaller chambers to look after.

All six chambers have seen a myriad of military equipment enter its doors, he said. From stealth bombers to air defense anti-tank systems, the test teams have seen and done it all. For that simple reason, Mr. Velasco said it's not only the military, but commercial companies that come to the lab to test their equipment.

"Companies come to us because we are usually cheaper, more exact and more convenient than actually going to that type of environment," he said. "I like to tell our customers — we don't simulate, we recreate the environments they want."

Those customers include Boeing and GoodYear Tires. These companies test everything from tires for cars to aircraft engines. Mr. Velasco proudly boasts that the McKinley Laboratory is the only facility in the world that can test full-scale aircraft and equipment. He said that this feat can only be accomplished using two very special pieces of equipment.

The first piece is aptly named the air make-up system. This vents the exhaust produced by mechanical engines being tested in the chambers and replaces it with fresh air. Not only does it replace the exhaust, it brings the air to the temperature consistent with the recreated environment. The system can cool air from 105 degrees Fahrenheit to minus 80 degrees Fahrenheit at 1,000 pounds mass per second.

The second piece of equipment is actually a group of three very large refrigeration units. He said the units are used to condition chambers and cold soak aircraft before engine runup. These units can take 135,000 pounds of R22 refrigerant and cool it to minus 5 degrees Fahrenheit.

For the hotter environments, the lab team uses 250-watt light bulbs. These bulbs can use up quite a lot of energy and that's one of the reasons the base rents the facility to commer-

cial companies, said Mr. Velasco.

"By renting out the facility, it cuts down the cost of maintaining it and saves the base money," he said. "Approximately one third of our testing has been for commercial companies during the past three years."

However, the facility doesn't come cheap, he added. Depending on which chamber and what type of testing needs to be done, billing can run from \$3,000 to \$15,000 a day. He indicated tests may be forced to run several days due to chamber conditioning and other factors.

#### Creator of the storm

Mr. Dwayne Bell is one of three test engineers at the climatic lab responsible for creating the chambers' extreme environments. He said creating these environments is not an easy task. Hours of planning and thought go into each environment.

Even though Mr. Bell has been doing his job for nearly 10 years, each test is different. The engineers select every nozzle, hose and fan that is involved in the test. He said his job can get even more difficult when the companies have a list of specifications they want.

"It's an engineering challenge to come up with a design satisfactory to the aircraft manufacturers," said Mr. Bell. "There's a lot of discussion how to design everything to make everyone happy."

He also said that his job not only includes creating the weather, but making sure the aircraft is properly restrained during testing. Without restraints, aircraft and equipment would slide across the floor and possibly cause damage.

Despite all these tedious details, Mr. Bell said he enjoys his job as much as the other engineers do. That's why he's been there for so long. "I'm basically the new kid on the block, and I've been here 10 years," he said. "You have a lot of longevity here because this job is a unique challenge."

While the engineers design the environments, it is the test support staff that make these dreams a reality.

#### Bringer of the storm

The test support team is the blue-collar section of the lab. Without the test support team there is no snow — there is no





fog, there's nothing. They are the ones who assemble and operate the equipment used in testing. From hanging up lights to washing down the chamber floors, test support is there.

The test support team has a dangerous job in the lab. They are the ones who operate the equipment inside these lethal environments. For 15 years Mr. Roger Judy has endured these extreme environments as the lab's test support supervisor.

He said safety is the top priority for test support. The team takes every precaution possible, from wearing the proper equipment to using the buddy system to prevent injury.

No matter what precautions are taken, he said there is no protection from the assault the senses receive when first entering one of these man-made netherworlds.

"The freezing cold is probably the most extreme environment I've entered. It burns your chest when you breathe in the air," said Mr. Judy. "Anything extreme is scary the first time you do it, but you learn to adapt."

The test support team's experience helps the military and commercial crews who have to be with the equipment as it is being tested. He said the test support team bonds with these other crews and it makes for a great work environment.

"We become part of the maintenance team," said Mr. Judy. "We support them and become a part of the mission. These pieces of equipment aren't just hunks of metal. You have to treat them like babies."

Mr. Judy said that the most interesting part of his job is seeing how these "babies" react in each environment. He said each piece of equipment can react totally different to the weather extremes.

Mr. Velasco agrees with Mr. Judy. He said as long as military equipment needs extreme environment testing, the lab will be in business. However, he added that the more commercial industry sees the benefits of using the lab, the more they will come.

"I see in the future as much as 50 percent of our clientele coming from the outside," said Mr. Velasco. "Our equipment is fairly new and there's a need for us. I don't see the lab going away."

- Mr. Greg Davenport, AAC Public Affairs

## AFRL Materials and Manufacturing Directorate Supporting Air Force systems

he Air Force Research
Laboratory Materials and
Manufacturing Directorate
located at Wright-Patterson Air Force
Base, Ohio, has many unique facilities
due to the nature of it's mission.

The directorate is responsible for developing new materials, processing and manufacturing technologies to use in aerospace applications (including aircraft, spacecraft, missiles, rockets and ground-based systems) and their structural, electronic and optical components.

It also supports Air Force weapon system acquisition offices and maintenance depots, solving materials-related concerns and problems. Other responsibilities include Air Force technology programs that address environmental issues and providing materials expertise for air base assets such as runways and infrastructure.

The following is a synopsis of a few of the unique facilities this directorate manages.

## Coatings Technology Integration

"The coatings technology integration office, opened in May 1998, is paying dividends to the entire Air Force community," said Maj. Barnard Ghim, CTIO program director.

"Since our grand opening in 1998, we have been extremely busy working aircraft coatings assessment and integration projects," he said.

"The Air Force is always looking for ways to reduce our hazardous waste," said Maj. Ghim. "Air Force Material Command Civil Engineering has been very aggressive in having us look at ways to reduce pollution in the way the Air Force depaints and paints aircraft."

The facility is designed to test and transition new paint coatings and increase the performance and environmental compliance of current aircraft paint coatings which will reduce effects of corrosion, while ensuring compliance with environmental guidelines.

The facility's success stories include the non-chromated tie-coat. Laboratory personnel worked with industry to develop a coating system without dangerous chemicals that met all the requirements, minus the corrosion.

"The material we developed passed

with flying colors and has been working great, eliminating a potential show-stopping hazardous material problem for the Air Force," said Maj. Ghim.

The facilities' ultimate goal is to improve paint coating systems performance for an aging aircraft fleet, thereby reducing costs, stretching resources and decreasing the environmental impact.

The showcase component of this facility is the environmentally controlled "paint booth." This unique and one-of-a-kind paint booth can simulate temperature and relative humidity conditions in order to replicate "real world" painting conditions of the field units and depots.

A smaller CTIO coating removal technology test facility is operated at Warner-Robins Air Logistics Center, Robins AFB, GA.

— Information supplied by Maj. Barnard Ghim, AFRL

#### **Dover National Test Site**

Operated by Material Lab's Air Expeditionary Forces Technologies Division at Tyndall AFB, Fla., the Dover National Test Site, located at Dover AFB, Del., provides the capability to conduct carefully planned, wellcontrolled experiments involving the release of contaminated liquids into portions of an aquifer.

The groundwater contamination test site then uses the results to develop new technologies to clean up chlorinated solvents, fuels and other mixtures at contaminated Defense Department sites.

"This facility is in high demand due to its unique capabilities in allowing the equivalent of live fire tests with dense contaminants and solvents," said Ms. Alison Lightner, project manager.

"Prior to the development of this site, experiments of this nature could not be conducted in the United States," she said.

Soil and groundwater contamination caused by industrial solvents pose a significant problem and a difficult cleanup challenge because common solvents, used for many years to maintain weapon systems, are heavier than water.

When spilled, they tend to filter through the earth until encountering a soil layer they cannot penetrate, forming a pool which can contaminate passing groundwater.

This one-of-a-kind test site allows

scientists to release contaminants and test faster and cheaper detection, monitoring and removal technologies, saving millions over conventional methods.

"At Dover, we have completely enclosed and hydraulically contained test cells and we have regulatory approval to put contaminants into the natural acquifer," said Ms. Lightner. "This makes the site a national resource which people all over the world want to use."

— Information supplied by Ms. Alison Lightner, AFRL

#### Materials Degradation Test Facility

The materials degradation test facility, located at Wright-Patterson, is a unique facility capable of evaluating erosion to a variety of materials and testing various materials for both rain and sand erosion.

The rain erosion-testing portion of the facility was created 30 years ago and has become the international standard for testing the erosion resistance of a variety of materials.

Information from more than 40,000 evaluations at this facility has been used to develop erosion resistant materials, advanced paint coatings, infrared windows and aircraft canopies.

"This facility is capable of simulating subsonic flight in a constant rainfall," said Ms. Lynne Pfledderer, program manager.

"The rotating arm is a double-arm blade eight-foot in diameter, designed to produce drip velocities of up to 650 miles per hour," she said. "Test specimens are exposed to one inch of simulated rainfall per hour, produced by raindrops which impact the test specimens randomly over their exposed surfaces," she explained.

In 1993, the particle erosion test apparatus, designed and developed to simulate effects of dust on aircraft surfaces, was added to the test facility. It provides controlled simulation of aircraft flying through particle clouds at high velocities.

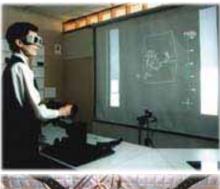
"This apparatus provides a wellcharacterized test environment at a modest operating cost, complementing our rain erosion test capabilities," said Ms. Pfledderer.

"Simulated dust environments are











Top left: Mr. Dan Varga paints an aircraft part in the CTIO environmentally controlled paint booth. Bottom left: Dr. Sean Kirkpatrick at work in the Ultrafast Laboratory. Middle: Dr. Vernon Bechel at work in the photomechanics Laboratory. Top right: Dr. Ruth Pachter mainpulates dye and polymer molecules in the Virtual Reality Lab while designing a laser hardening material. Dr. Pachter 's the leader of the Materials and Manufacturing Directorate's computational materials research team. Bottom right: The simulated rainfall in the rain erosion test facility, produced by pressurized quandrants as shown above, evaluates erosion on a variety of materials.

produced by accelerating dust particles in a high-speed gas jet and causing the jet to strike a test specimen," she said. "Specimens are moved horizontally and vertically during testing to produce a uniform exposure to the particles."

The University of Dayton Research Institute is the on-site contractor operating the Materials Degradation Test Facility, which can be used for both commercial and government tests.

— Information supplied by Ms. Lynne

— Information supplied by Ms. Lynne Pfledderer, AFRL

## Photomechanics Laboratory

The photomechanics laboratory, located at Wright-Patterson, evaluates materials that may help strengthen composites used to build aircraft and space vehicles.

Recently expanded, the lab assesses the behavior of composite materials used to make aerospace components.

Three widely accepted test methods to evaluate the composite materials are used: moire interferometry, photoelasticity and microscopic observation.

These methods provide a costeffective means and highly accurate capability for assessing the strength characteristics of composite materials. The results are expected to lead to a better understanding of the nature of composite materials.

— Information supplied by Dr. David Mollenhauer and Dr. Vernon Bechel, AFRL

## Virtual Reality Laboratory

The virtual reality laboratory, located at Wright-Patterson, is one of the most advanced facilities for computational materials design in the United States.

Researchers at this facility explore design of new materials, such as certain organic materials, biologically based systems and liquid crystals. These materials appear promising, yet challenging.

The virtual reality laboratory develops fundamental theories and computational approaches to help researchers and enhance the capability for real materials design.

To complement these design efforts, the laboratory helps visualize data through virtual reality programs when studying the reaction of molecules of various materials. The growing capabilities offered by this advanced visualization and computing have potential applications in designing materials and drugs, studying surfaces and defects, flight simulation and education.

- Dr. Ruth Pachter, AFRL

## Ultrafast Physics Laboratory

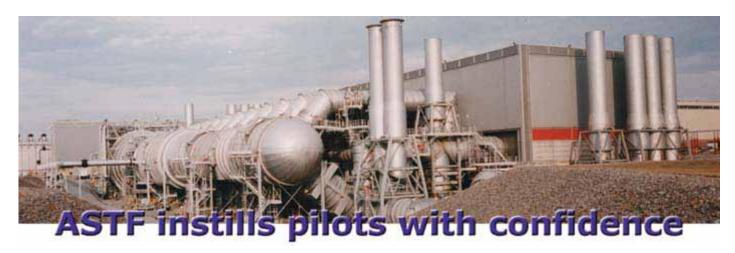
The ultrafast physics laboratory, located at Wright-Patterson and operated by Material Lab's Hardened Materials Branch, is an advanced laser laboratory designed to help develop revolutionary materials using highenergy, high-repetition, ultrafast laser pulses in a wide array of experiments.

Experiments at this facility investigate the properties of various materials and create micro-electro-mechanical systems. Several laser experiments are available to examine the molecular properties of various materials.

These experiments make up the main measurements for analyzing materials and are used to establish structure-to-property relationships and model construction.

As future Air Force and defense department missions depend more heavily on optical systems and novel materials development, this versatile facility will serve as a valuable resource, providing a fundamental screening of materials.

— Dr. Sean. Kirkpatrick and Dr. Paul Fleitz, AFRL



Pilots don't expect perfect conditions, but they do expect their plane's engine to perform perfectly no matter the environment.

Testing aircraft propulsion systems in true mission environments without leaving the ground is the mission of the Aeropropulsion Systems Test Facility, or ASTF, located at Arnold Air Force Base, Tenn.

The only test facility of its kind in the world, ASTF provides a simulated altitude environment duplicating an aircraft's flight envelope. It tests thrust capabilities and fuel usage in jet engines with up to 100,000 lbs. of thrust at altitudes up to 100,000 feet and speeds up to Mach 3.8.

#### **Setting records**

It is an open-circuit facility housing two test cells. The facility, which during construction used nine months of the nation's steel production, contains 320 miles of electrical cable and the world's largest butterfly valve 32 feet in diameter and weighing 170 tons —according to the Guiness Book of World Records.

At \$625-million, ASTF is the largest single-line-item military construction project in Air Force history. Congressional and presidential approval for construction was granted in September 1976. Construction began in 1977. It took seven years and more than 1,000 workers to build the facility, which reached initial operation capability in September 1985.

#### **Simulating flight conditions**

During testing, atmospheric air is compressed, heated or cooled, as required to simulate flight conditions, and supplied to the propulsion system in the test cell.

The air supply compressors provide up to 1,500 pounds of air per second into the test cell to simulate airspeeds up to more than 2,000 miles per hour. The compressors, totaling 215,000 horse-power, are started by the largest variable frequency starting system in the western world. An additional 1,400 pounds per second of airflow is available by drawing outside air directly into the test cell.

A massive refrigeration system is used to duplicate the flight environment for high altitude and low-speed missions. Two large coolers and enough refrigeration equipment to cool 6,000 average American homes are available to dry and cool the air to minus 20 degrees Fahrenheit. The air can be cooled to as low as minus 100 degrees Fahrenheit if required.

Providing properly conditioned air to the propulsion systems to simulate supersonic flight conditions calls into play the largest air heaters in the western world. These heaters can burn either natural gas or waste aviation fuel and generate enough heat — one billion Btus per hour — to raise the temperature of the airflow to a maximum of 1,020 degrees Fahrenheit, which is enough to heat 2,200 average houses on a subzero windy day.

Currently, the ASTF cells are testing F119 engines for both the F-22 Raptor and the Joint Strike Fighter.

— Ms. Darbie Sizemore, AEDC public affairs

#### Continued from page 9

onds — about the time light travels across a room. It consists of a pulse power train with 288 high-energy storage capacitors that store electrical energy for a short period of time.

During a test, operators charge these capacitors with up to 100,000 volts of electricity. Then they discharge the capacitors to produce a 10 terawatt-pulse electron beam that impacts on a target producing the X-ray pulse.

Sensors, on or near the test article, measure and document the amount and type of X-rays produced. The entire sequence takes approximately two minutes.

According to Mr. Lavell Whitehead, test contractor project manager, the system will provide nuclear weapons effects testing at a much lower cost than underground testing.

"With previous ground tests, you got one shot at it," said Mr. Whitehead. "If something went wrong a whole year's effort and money could be lost. With Decade, if something goes wrong, it can be repeated within a couple of hours at minimal cost."

"The Decade team," said Mr. Brandon, "is working very hard to provide the nation's premiere nuclear weapons effects test capability at the lowest possible cost to the consumer."

#### **Rocket testing**

Arnold's Rocket Development Test Cell J-4 provides unmatched liquid-propellant rocket engine and solid-propellant rocket motors testing.

Built in the early 1960's, J-4 is an 82-foot-tall vertical test cell providing simulated altitude testing up to 100,000 feet. With its large-volume vertical dehumidification chamber reaching 250 feet below ground level, it can support engines with thrust levels up to 1.5 million pounds.

In addition, J-4's unique temperature-conditioning system is designed to maintain the test article at temperatures from 50 degrees to 110 degrees Fahrenheit.

Special chamber studies hypersonic vehicle structures

In 1903 the Wright-Brothers began the first powered airplane flights at Kitty Hawk, North Carolina and taught the world how to take off into the wild blue yonder.

The Air Force Research Laboratory's Air Vehicles Directorate continues in Wilbur and Orville's tradition by soaring in the areas of aerospace research and continuing to ask the question, "How fast and how high can we go?"

However, upon entering the jet age, aircraft began to show structural problems unique to the high thrust propulsion systems that helped them to get off the ground in the first place.

High on the list of these problems is sonic fatigue caused by fluctuating pressures from propulsion systems and aerodynamic turbulence. To study the problem, the Air Force designed and constructed the sonic fatigue facility at Wright-Patterson Air Force Base in the 1960s.

As technology continued to surge forward, aircraft became faster, higher flying and began to operate in more extreme environments. The sonic fatigue facility evolved and improved to continue advancing aircraft structures and materials technology.

One of the unique test chambers the Air Force Research Laboratory now operates is the Combined Environment Acoustic Chamber, or

CEAC. The facility was designed and constructed in the early 1990s to study hypersonic vehicle structures that must survive extreme thermal and acoustics loads.

Hypersonic is speed equal to, or exceeding, five times the speed of sound.

Key test capabilities consist of accurate and repeatable sixcomponent thrust measurement, variable altitude and soft shutdown capabilities to preserve hardware.

Additional capabilities include providing nozzle development and deployment, ignition performance, long-duration altitude (mission duty cycle), heat transfer effects and post-test heat soak, vibration and dynamics, failure analysis and vertical spin testing.

In 1996, a \$9.7 million upgrade added new cryogenic and hypergolic propellant system test capabilities, and in 1997, J-4 was the test site for the first engine to power a new generation of space launch vehicle upper-stage propulsion systems, the Evolved Expendable Launch Vehicle.

"The Arnold J-4 facility has capabilities unmatched anywhere in the world," said Mr. Don Skinner, J-4 program manager and coach of the space and missiles department missiles and rockets branch. "With the new upgrades, the facility is ready to support upper stage engine testing to reduce

The facility and its technology can also be used for testing many other structural configurations such as reusable launch vehicles.

As new materials and struc-

designed for severe environments, the CEAC is a tool that can test these new designs to make sure they survive.

The CEAC is an acoustic progressive wave tube that includes twelve noise modulators which generate the acoustic energy.

Specimens in the CEAC are also heated by quartz lamps that can provide a extreme radiant heat source.

The sidewalls directly exposed to the quartz lamps are polished to mirror clarity in order to reflect radiant energy to the test specimen.

The test items can be subjected to extreme heat

fluxes, enough to bring some test articles to temperatures up to 3000 degrees Farenheit.

Research in this facility will continue to provide the fundamental physics and engineering data essential for building future simulation and modeling tools, and enable simulation-based development of aerospace vehicle structures.

— AFRL Air Vehicles report

risk and improve reliability of propulsion systems for the Defense Department and commercial missions."

Because of its large size and accessibility, J-4 can accommodate an extensive range of diagnostic instrumentation able to acquire up to 500,000 data samples per second.

#### Today and beyond

Today Arnold is helping develop the F-22 Raptor, the Joint Strike Fighter, the Navy's F/A-18 Super Hornet, and helping to keep the F-15 Eagle, F-16 Fighting Falcon, B-1 Lancer and B-2 Spirit on the cutting edge of flight technology.

In addition, the center has long-term alliances with Pratt & Whitney, General Electric, Boeing and Lockheed Martin to test commercial flight systems like the engines for the Boeing 777.

Last year about 16 percent of Arnold's work was commercial, helping to offset the cost to the taxpayers of operating and upgrading facilities to support the national defense.

- Mr. Claude Morse and Ms. Tina Barton, AEDC Public Affairs

## Starfire telescope shows things clearly

top a 6,000-foot peak in the southeastern portion of Kirtland Air Force Base. N.M., is the Starfire Optical Range where the world's premier adaptive optics telescope is housed. Capable of tracking low-earth orbiting satellites, here is where technologies were pioneered that allowed astronomers to see space objects clearly through the distorting effects of the atmosphere.

#### Capabilities

Starfire Optical Range maintains a telescope with a 3.5-meter-diameter (11.5 feet across) primary mirror, which

is protected by a unique retracting cylindrical enclosure that allows the telescope to operate in the open air. Using lasers, a sophisticated computing capabil-

ity and adaptive optics, the telescope is able to distinguish basketball-sized objects at a distance of 1,000 miles into space.

This world-class optical research facility is the center for Air Force strategic optical research. Starfire's primary mission is to develop optical sensing, imaging and propagation technologies. It is a major component of the Air Force Research Laboratory's Directed Energy Directorate.

#### **Description**

The lightweight, honeycombsandwich primary mirror weighs 4,500 facesheet. The surface is precisely polished to 21 nanometers, or 3,000 times thinner than a human hair. There are 56 computer-controlled actuators behind the mirror to maintain its shape while the telescope is moving.

pounds and has a one-inch-thick glass

#### **Unique feature**

A unique feature of the telescope is its protective enclosure: Its "walls" consist of three 70-foot-diameter, 9-foothigh cylinders, aligned on top of each other to resemble a large can. These cylinders retract - an operating mechanism that resembles an inverted collaps-

ible camping cup. As the cylinders drop around the telescope, the telescope "looks out" through a 35foot-diameter

ball-sized objects at a distance of 1,000 miles.

The Starfire telescope is

able to distinguish basket-

shuttered opening in the roof.

This enclosure has two major advantages over conventional telescope domes that are equipped with narrow slits: the enclosure does not have to be rotated at high speed for satellite tracking, and it improves image quality by releasing warmer "trapped" air that could create optical distortions.

The combined weight of the telescope, gimbal, optics, and support structures exceeds 100 tons. The telescope sits on a massive, steelreinforced concrete pier that weighs more than 700 tons and which is isolated from the rest of the facility and anchored in bedrock with long steel rods.

Thermal control of the telescope and facility is essential to obtaining high quality images. A unique feature of the facility is the removal of heat by a closed-cycle water system chilled by a large "ice house" located a quarter-mile from the telescope. In the daytime, ice is made and stored in an underground pit for use at night. The pit, beneath the floor of the physical plant, can hold 4.5 million pounds of ice.

Propane-fired boilers can generate up to 2 million Btus for hot water, which is also supplied to the telescope facility. Very precise temperature control of optical labs and equipment can be achieved by mixing the right proportions of hot and chilled water, which then conditions air and equipment in the facility. Unlike conventional air conditioning systems, this method prevents heat from being released into the air near the telescope.

Total cost of the telescope, enclosure, laboratories, physical plant, and supporting facilities was \$27 million.

The research and operations staff is comprised of approximately 80 military, civilian and contractor personnel. Included in the staff are physicists, mathematicians, astronomers, electronic and mechanical engineers, optical designers and technicians, sensor and computer specialists, laser technicians, meteorologists, electricians, plumbers, welders and machinists.

- Mr. Rich Garcia, AFRL Public Affairs

## Edwards develops "exotic" technology

Researchers at the Air Force Research Laboratory facilities at Edwards Air Force Base, Calif., are developing future technologies for spacecraft propulsion systems.

Propulsion Directorate researchers have built a new and unique lab for creating and transitioning technologies which were considered "exotic" only a few years ago. The Electric Propulsion Lab has expanded its research facilities over the past twenty years as materials and research have resulted in lighter-weight, more efficient propulsion designs.

As the Air Force moves into the new century, its satellites are being miniaturized. Electric propulsion technologies can be used to insert the satellite into final orbit, conduct the station-keeping propulsion during the lifetime of the craft, and even efficiently move from one orbital position to another and return. This provides the warfighter with versatile tools that are respondent, reliable and cost efficient. To maintain those characteristics, their on-board space propulsion requires high efficiency impulse performance. The system's size and weight are also critical.

AFRL's electric propulsion research develops impulse thrusters that significantly decrease the propulsion system size, when compared to conventional chemical propulsion systems. It also establishes the national research capability to advance electric propulsion technology. The facility is available for use for cooperative university studies and Small Business Innovative Research, or SBIR, efforts.

There are six unique vacuum chambers used to mimic the conditions of space where electric propulsion systems operate at top efficiency. One of the chambers is the largest in the Air Force devoted to this type of propulsion. The chamber's instrumentation is able to validate basic research, measure thruster performance, and perform long-duration (7,200 hour) life tests.

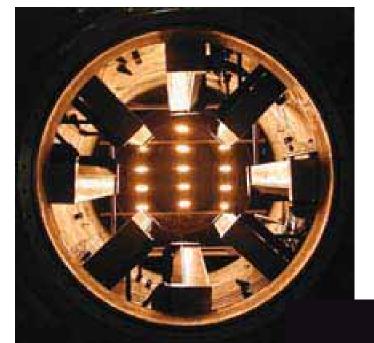
Some of the lab's technology developments are in orbit now, part of the largest Air Force scientific research satellite ever placed in space. Known as Arcjet Propulsion, its demonstration in orbit last year on the ARGOS Satellite not only validated the technology but also represented the largest power sub-system ever used in space. On-board instruments measured it's effects on spacecraft hardware and electronics, assuring future users that there were no detrimental effects from using the propulsion technology in space.

The lab's large vacuum chambers that simulate space conditions and allow researchers to observe and validate their technical studies also support other major electric propulsion efforts including hall thrusters and pulsed plasma thrusters. These technologies will provide an array of choices for satellite designers, answering future Air Force needs for next-generation satellite systems.

All this research is conducted under the guidance of the propulsion mantra of Integrated High Payoff Rocket Propulsion Technology or IHPRPT. IHPRPT is the consensus planning and goal of doubling rocket propulsion capabilities over a fifteen year span by increasing performance, reliability and decreasing costs. The Propulsion Directorate is the executive agent implementing and guiding the goals of the Defense Department services, NASA and the rocket industry.

The Electric Propulsion Lab is unique within the Air Force, but it is only one feature of many at the Propulsion Directorate's 65 square mile, rocket propulsion research facility at Edwards, answering the future needs of the Air Force.

- Mr. Ranney Adams, AFRL Public Affairs



#### Museum exhibit recalls "the forgotten war"

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A hallowed silence greets observers as they enter the new exhibit at the U. S. Air Force Museum, Wright-Patterson.

The actual setting is the museum's exhibit commemorating the 50th Anniversary of the Korean War. Entitled "Korea Remembered: The U.S. Air Force Comes of Age," the exhibit recalls "The Forgotten War" by spotlighting the emergence of the modern Air Force and its evolution into a lethal air arm though only in its infancy as a separate service.

"The overarching theme of the exhibit is to show the Air Force in transition from the Army Air Forces in World War II to the modern Air Force, ready to tackle the challenges of the Cold War," said Mr. Jeff Duford of the Museum's Research Division.

"We wanted to put the war within a greater historical perspective rather than just recount events, especially since this was the first war for the newly independent Air Force after its inception in 1947," he said.

"This exhibit is for those Air Force veterans who served in Korea; it's their moment to stand and be recognized," said Mr. Jeff Duford of the museum's research division.

"It's also a time to remember those who didn't come back. We wanted to create something that would grab our visitors' attention and draw them in to read about those veterans of so long ago."

— Mr. Chris McGee, U.S. Air Force Museum public affairs

## Contracts awarded to build space mirrors

KIRTLAND AIR FORCE BASE, N.M. — Four contracts totaling nearly \$14 million for the next phase in development of large, extremely lightweight mirrors for space, were awarded recently under a collaboration by the Air Force, NASA and the National Reconnaissance Office, or NRO.

The contracts were awarded by NASA's Marshall Space Flight Center in Huntsville, Ala., to the Raytheon Company of Danbury, Conn.; Eastman Kodak of Rochester, N.Y.; and Ball Aerospace of Boulder, Colo. Raytheon received two contracts. The three contractors will continue with the work they initially started in the program.

Known as the Advance Mirror System Demonstrator, this collaborative effort to develop advanced, light-weight mirrors for next-generation optical systems in space is sponsored by NASA's Next Generation Space Telescope program project, the NRO, and several Air Force organizations.

Participants include the research laboratory's Directed Energy and Space Vehicles Directorates here and the Space Based Laser System Program Office at Los Angeles AFB, Calif.

The Air Force needs large mirrors in space to use with low-power lasers for remote surveillance or with high-power space-based lasers for defense against long-range missiles.

For these uses, mirrors are needed that range in size from 12 to 48 feet in diameter. For comparison, the mirror on the Hubble telescope is 7 feet, 9 inches across.

- Mr. Rich Garcia, AFRL public affairs

## Consortium seeks to improve communications

ROME, N.Y. — The Air Force Research Laboratory Information Directorate has joined with two other New York technology organizations to form a telecommunications research consortium dedicated to improving regional telecommunications and stimulating the area's economy.

The New York Advanced Communications Environment is being established at Syracuse University to advise community organizations about new communications technologies, and to experiment with technologies for strengthening the telecommunications infrastructure in the local area.

The consortium also includes the New York State Technology Enterprise Corporation and the Syracuse University Community and Information Technology Institute.

New technology will allow classes to be taught by college and continuingeducation faculty members in subjects such as language, communications, financial management, technology basics and citizenship. New Yorkers would be able to take these courses via the Internet.

The idea for the consortium was born out of a series of recommendations the organizations made to the state in a comprehensive study called the New York State Advanced Telecommunications project.

The study examined the state government's existing telecommunications infrastructure and recommended more effective uses for new technologies.

- Mr. Francis Crumb, AFRL public affairs

## Global Hawk team visits Tinker community

TINKER AIR FORCE BASE, Okla. — Members of the local community gathered June 21 at Del City's Huey Long

Community Center to discuss the possibility of bedding down the Global Hawk Unmanned Aerial Vehicle at Tinker.

Col. Robert Gambrell Jr., 72nd Air Base Wing commander, opened the meeting.

The Air Combat Command Global Hawk Scoping Team addressed environmental impact issues and provided an overview of the Global Hawk mission.

The public meeting received positive comments from both citizens and community leaders in attendance. Representa-

tives from area chambers, led by retired Lt. Gen. Richard Burpee, described the supportive central Oklahoma commu-

nity. "Tinker is a very dynamic economic aspect of our community," said Mr. Stan Greil, executive director of the Midwest City Chamber of Commerce.

Local community leaders told the team why they thought the systems should be placed here.

The other locations considered as possible sites for the Global Hawk are Edwards AFB, and Beale AFB, Calif., Wright-Patterson AFB, Ohio

and Ellsworth AFB, S.D.

— OC-ALC report

## New software keeps Air Force secrets secret

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magine if you told an F-16 pilot to attack a target 550 miles away and then learned the plane's maximum range was only 500 miles.

Or suppose you ordered a C-5 to deliver cargo to an airport where the runway was too short for the plane to land.

Couldn't happen? The Air Force isn't taking any chances. Today's mission planners use the Global Command and

Control System, or GCCS, a computer application that is run on a Defense Department secure network, to plan missions and issue air tasking orders, said

Capt. John Casebolt, GCCS engineer for Hanscom Air Force Base, Mass., Command and Control Centers and Applications Product Area Directorate. This system ensures that units aren't asked to do two missions at the same time or given jobs that are impossible to complete.

But can you imagine if a hacker broke into the system and made a few subtle changes. What if he added an

extra 10 percent to the maximum range of an F-16, or changed a C-5's needed landing distance from 1,493 meters into 1,493 feet. The results could be catastrophic.

Beefing up the system

That is why the directorate, a division of the Defense Information Infrastructure Systems Program Office, is working to add more beef to an already secure network.

"Intrusion detection software installation has been mandated by the Joint Staff in order to provide a secure environment for our command and control customers," said Lt. Col. Howard Gans, GCCS program manager. Instead of spending valuable resources developing a security program from the ground up, the directorate sought an existing solution from the vast commercial network security market.

The answer is the Computer Misuse Detection System, or CMDS, a product developed by Intrusion.com, a company based in Richardson, Texas.

"This is a perfect example of a commercial off-the-shelf product being used for military applications," said Tech. Sgt. Tim Craig, GCCS information systems security officer.

The program has been purchased and is being successfully used by several other government and industry customers, said Ms. Davee Webb, who works at Intrusion.com's Security Division in San Diego, Calif.

#### Looking for system abuses

Unlike an anti-virus program, which looks for known pieces of malicious computer code, CMDS is designed to detect someone trying to break into or misuse the system.

The system collects audit records and breaks them into readable network reports. The reports are used to get an

overview on potential attacks against the system by an inside or outside threat," said Sgt. Craig.

The program watches for certain indicators of an attack. "It tells you the most critical events," said Ms. Webb. When an event is detected, the software flags the activity and issues a warning to the network administrators.

"It gives us the ability to see unknown users and also detect

unusual activities by known users," said Capt. Casebolt. This is important considering the current growth rate of the secure network. As more tasks are automated, more people find the need to access the network.

"Right now, it's fairly easy to track user activity but over time that will get worse," said Master Sgt. Tony Collins, an Air National Guard systems administrator assigned to the 186th Air Refueling Wing at Key Field in Meridian, Miss. "CMDS makes

tracking that activity manageable. You can actually profile what a specific user is doing," said Sgt. Craig.

said Sgt. Craig.

Watching for attacks from within is particularly important. Since it is a classified system, potential intruders would need some inside help to get in," said Capt. Casebolt.

This help could come in the

form of poor entry control procedures into secure areas or improper password control. Recent events like the theft of a laptop loaded with classified information from a State Department conference room highlight the need for security.

"Even if someone could gain access and steal a password, CMDS will record the location, every action taken and sound an alarm so network administrators can shut that system down," he said. "It can tell if someone who is supposed to on leave tries to log on to the system," said Sgt. Craig.

#### System accreditation

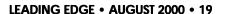
Computer Misses Detection System (CHRS) Start Server: 'code' - Gomes expires for this server \$1500000

The directorate has taken on the monumental task of getting it accredited. "We've spent a lot of time to ensure it would work with all our hardware and software, and that it was Defense Information Infrastructure and Common Operating Environment compliant," said Capt. Casebolt. "Now we're going for an Air Force level accreditation."

In the meantime, the directorate has been working along with company representatives from Instrusion.com to get the software operational worldwide.

Bringing this software online is the equivalent of having a digital watchdog sitting on the perimeter of the network. Ensuring that when air planners use the GCCS to issue orders to put bombs on target, they send the right planes to the right place at the right time.

- Master Sgt. Daryl Mayer, ESC Public Affairs





## Tiger team studies C-5 program

Office. "We have a critical mission weapon system that is extremely complex. The people are doing their very best. We need to make sure everything is optimized to help them."

is extroplex. doing we new optimit them."

tiger will often stalk the back of a herd, picking off a slow or injured animal for an easy meal. Tiger teams in the Air Force attack the weaker links in the mission chain with all the fury of a Siberian tiger striking a deathblow to its prey.

Killing problems while strengthening readiness is exactly the aim of a tiger team tearing into the complexities of the C-5 Galaxy program to help improve the availability and sustainability of the Air Force's largest transport aircraft.

The C-5 weapons system is a critical component in the worldwide deployment of military and humanitarian assets. Throughout the years, it has consistently met this need, but only through the efforts of those who use, support and maintain the system. However, the aircraft has consistently fallen short of its requirement to maintain the mission capable rate necessary to meet the warfighter's airlift needs, said C-5 program officials.

#### **Capability issues**

Recent declines in mission capability — how many of the 126-aircraft fleet are available at any given time — prompted senior Air Force leadership to take decisive action. Air Mobility Command and Air Force Materiel Command commanders directed the formation of a tiger team to identify opportunities to improve the availability, reliability, and maintainability of the aircraft; all factors in the C-5's mission capability.

Air Force officials are quick to point out that policies and processes — not people — are what they are aiming to improve.

"Let there be no question that this is about what is wrong, and not about who is wrong," said Mr. William Cromer, deputy director, Warner Robins Air Logistics Center C-5 System Program

#### **Reversing trends**

If reversing a declining trend were simple, a simple approach would be used. A myriad of factors have contributed to the problem, however. The team will attempt to delineate and place into context all of the issues, separating those within the Air Force's control from those beyond their control which must be considered.

Their approach will be to take a comprehensive, fresh look at governing policies, maintenance and repair procedures, and best practices by conducting field surveys at home stations and supporting depots, noted tiger team officials. The team will identify problems, generate solutions and make recommendations for long-term and short-term improvements, while seeking to develop performance measures that will support an integrated C-5 balanced scorecard.

Split into two groups that will deploy to a dozen U.S. bases this summer, the team hopes to develop the most complete picture of the C-5 program ever with a focus on details in the areas of operations, maintenance, supply, sustainment, and logistics support.

The field operations sub-team, led by Col. Ken Higashihara from headquarters AMC, will visit home stations and operating locations. The objective of the field operations team is to validate each unit's compliance with current Air Force, major command and other regulatory instructions.

From both logistics and operational perspectives, the team will focus on the impact of compliance or non-compliance on mission capability, as well as any internal or external impediments caused by regulated processes or command-directed compliance. The team will also evaluate the relationship

of unit metrics and standards with mission capability. This comprehensive approach will enable the team to identify problems, generate solutions, and make recommendations for immediate and long-term improvement, said Col. Higashihara.

The depot operations sub-team, led by Col. Gary McCoy from headquarters AFMC, will be split into two main efforts: depot production and program/ supply chain management teams.

Col. Jim Russell, headquarters AMC, heads the depot production element, which will review both aircraft and commodity production issues.

The program and supply chain management team is led by Col. Louise DeWilder, headquarters AFMC, and will review C-5 system program office program management issues as well as any supply chain management issues impacting any organization supporting the C-5 aircraft. This element of the tiger team will be seeking ways to improve Air Force, major command and any other supply management or contracting policies, instructions, or other guidance that impact C-5 support.

"We have just started our visits and it is great to see the open communications between all of the team members and their WR-ALC counterparts," said Col. DeWilder, "Everyone is supportive and enthusiastic about the team, and we hope one of the biggest payoffs will be that many of the improvements or new opportunities implemented for the C-5 can be applied to other weapon systems."

#### **Team emphasis**

Senior tiger team members are quick to point out that the team's emphasis will be to focus on "as is" processes for improvement and to encourage "outside the box" thinking. "Everyone agrees that we need to make some changes now that can give us significant benefits in the short term. That's the purpose of the team," said Mr. Cromer. "Then we must carry their lessons toward continuing improvements in C-5 maintainability, reliability and availability."

"With major modernization and reengineering projects in the next several

— Continued on page 21

## Airborne laser completes atmospheric tests

To the casual observer, it seemed easy enough: Take an Air Force plane and use it to find out what the atmosphere would do to a beam of laser light fired over a long distance. That job was more involved than it sounded. It took 54 people from nine organizations, a month and a half away from Kirtland Air Force Base, N.M., more than 150 flying hours over six countries, and operating two very sophisticated sensors.

Officials at the Air Force Research Laboratory's Directed Energy Directorate expressed satisfaction with the test series. The collected data thus far indicates that the effects of the atmosphere will not adversely affect a laser beam more than anticipated. This is welcome news for the airborne laser— a jumbo jet that will carry a laser capable of destroying missiles from hundreds of miles away, meaning the warbird's laser will not be hampered by atmosphere over the ranges.

At the heart of the tests were two unusual instrumented systems: a stellar scintillometer and an anemometer.

"Flying at altitudes between 39,000 and 47,000 feet, we used the scintillometer to focus on individual stars," said 1st Lt. Dawn Grover, test program manager. "The scintillometer processed returning light from those stars to determine to what extent atmosphere might distort a beam of laser light."

According to 1st Lt. Patrick Kelly, a flight test engineer on the program, the second piece of equipment — an anemometer — collected "outside" information at the rate of 6,000 samples per second. "Its most distinctive feature is a set of four-pronged wires, about the thickness of a human hair, that protrude from a housing beneath the nose of the aircraft," said Lt. Kelly. These sensors measure the temperature and velocity of the air through which the plane is flying. Incredibly sensitive, this sensor can detect temperatures to within 1/1000th of a degree while the plane is flying 475 mph."

Although the plane spent time in Alaska, England, Japan and Singapore, the majority of testing took place in Doha, Qatar, in the Middle East, and at Osan Air Base, Korea, in the Far East. Each trip has been at different times of the year, to see how data might vary in different seasons.

The test plane, a modified Air Force C-135E aircraft named Argus, is owned and flown by a crew from Detachment 2 of the 452nd Flight Test Squadron at Kirtland. Management of the aircraft and the test programs it supports comes under the Active Remote Sensing Branch of AFRL.

Argus is designed as a flying laboratory to gather a wide variety of data. It carries electro-optical sensors that can be tuned to gather technical information across the light spectrum (visible, ultraviolet, and long-wave infrared). Its sensors can collect radiometric imagery, spectroscopic data and measure



Checking the alignment of optics on a stellar scintillometer are Maj. Kim McCrae, left, chief of the Airborne Laser Technologies branch, and Capt. Jason Gale, chief of Systems Engineering.

atmospheric turbulence. Airborne light detection and ranging systems can be installed for remote sensing of the atmosphere. The aircraft can be adapted for any flying experiment up to 20,000 pounds.

Mr. Wayne Wasson, Argus program manager, said the aircraft can operate at up to 50,000-foot altitudes for 12 hours at a time. "We use Global Positioning System satellites and an Inertial Navigation System to assure precise navigation and timing," he said.

"Over the past few years, we conducted a variety of experiments: one used a laser beam to scan an area, sensing for environmental contaminants in the air. Another project assessed a communications device that relayed information to a battlefield commander via satellite. Yet others examined plume phenomenology — that is, information about a missile from its exhaust trail."

Among the other organizations that supported the data collecting campaign were a team of security policemen from the 610th Security Forces Squadron at Carswell Naval Air Station, Texas, and balloon specialists from the research laboratory at Hanscom AFB, Mass.

This last group also gathered atmospheric data, but from sensors carried aloft by large, high-altitude balloons. The aircraft-gathered and balloon-gathered data were combined and compared for more precise, in depth information on atmospheric conditions.

- Mr. Rich Garcia, AFRL, Public Affairs

#### Continued from page 20

years," he continued, "what we implement now through this effort will help us move smoothly through those future phases without a dip in C-5 availability."

The tiger team began installation visits May 30 that have included Altus AFB, Okla., Kelly AFB, Texas, and here. Also on the schedule are visits by the field operations element to Travis AFB, Calif., Dover AFB, Del., Stewart Air National Guard Base, Mass., and Westover Air Reserve Base, Mass.

The depot operations sub-team will travel from Robins to Oklahoma City-ALC at Tinker AFB, Okla., Ogden-ALC at Hill AFB, Utah, Defense Supply Center-Richmond, Virginia; and San Antonio-ALC, Texas.

After completion of the team's effort, a comprehensive report will be made to major command commanders with recommendations for improvement.

— WR-ALC Public Affiars and C-5 SPO officials report



A C-5 undergoes program depot repair at Robins Air Force Base, Ga.,

# Tinker partners with industry in technology and development

any people think all an Air Force base does is work on aircraft and other things military, but Tinker Air Force Base, Okla., often goes beyond the usual mission.

Almost five years ago, Tinker helped develop the technology for what may very well become a cure for working hands around the world.

Under a 1995 Cooperative Research and Development Agreement, or CRDA, Tinker helped develop a device to begin the process of testing and alleviating carpal tunnel syndrome.

The CRDA projects allowed private companies to share in the technology developed by the government.

One of Tinker's aero engineers, Mr. Dave McBride, assisted Mr. Roger Williams, CEO of Midwest City Therapy, Inc. and president of Theraid Manufacturing Inc., in the development of a desktop machine which measures displacement of wrist movement.

Mr. Williams is now in his third generation project designed to build supports or braces for weak or ineffective joints or muscles [orthotic].

#### **Innovation**

Mr. Williams is at a point now where he is being recognized in the medical and therapy community as an innovator and leader in this specialty area," said Mr. Al Rich, deputy director, Contract Logistics Support Directorate. "From the rudimentary design our engineers helped him with years ago, he has now developed a device that he can put on people to help prevent damaging repetitive motion and recover from repetitive motion injuries."

According to Mr. Williams, Mr. McBride helped engineer a platform out of aircraft aluminum using his ideas and wooden prototype. "The addition of a load cell and a sensitive linear recording device attached to a carriage for the hand provided the first operational forced displacement tool."

"His theory," said Mr. McBride, "was that resistance was directly related to the onset of carpal tunnel. We put his theory to work and developed a machine to measure resistance and proved that resistance averaged between 10 to 30 pounds. He said he was going to take this information and develop some type of orthotic device — I guess he did it."

Conventional therapy proposes that carpal tunnel syndrome typically affects the tendons, nerves and bones of the wrist. The syndrome is caused by repetitive movement or awkward positioning of the hand and arm during manual tasks. Mr. Williams is proposing that this syndrome is caused by a deformity from environmental circumstances

#### **Computer-generated testing**

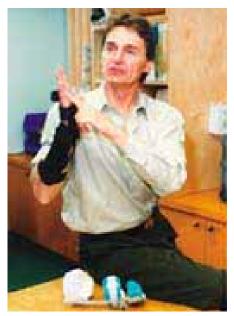
"Prior to Tinker's assistance, our only way of testing was through manual tests," said Mr. Williams. "Thanks to them, we were able to create a device that allowed us to begin the process toward computer-generated testing, which provides a signature of a wrist similar to an EKG reading, to discover more about the cause and cure."

When Mr. Williams first started conceiving the idea of an orthotic for carpal tunnel, he was treating Mr. Rich, who was injured on the job and undergoing therapy on his left hand. It was through Mr. Rich he learned of the CRDA projects.

"At that time the CRDA projects were going strong," Mr. Rich said.
"When Roger and I met, he expressed an avid interest in carpal tunnel syndrome and repetitive motion injuries. He had an idea and some designs regarding the possible prediction of these injuries before they became a major medical problem for people.

#### Therapy counseling

"Roger came to us to see if we could help with the design of a measurement device, which would help him measure



Ms. Margo Wright, OC-ALC

Mr. Roger Williams, CEO and president of Midwest City Therapy, Inc., worked for years to develop a splint he believes will cure carpal tunnel syndrome. Mr. Williams credits Tinker AFB, Okla., with helping develop his idea into the prototype he is demonstrating here.

the resistance," he continued. "In turn, the government received employee therapy counseling sessions from him, which was a good trade for us since we had a lot of that going on.

"I'm very excited about his progress because I feel it has its roots in the CRDA program," concluded Mr. Rich. "And out of our joint effort, if you will, has grown something very good."

#### First of it's kind

Because of Tinker's early assistance, Mr. Williams will be releasing an orthotic device that may be the first of its kind to possibly alleviate carpal tunnel syndrome.

Mr. McBride is proud of the help he provided in the development of a possible cure. "I feel like I had carried him to the point where the idea and the machine could really be developed."

"Without the CRDA project," said Mr. Williams, "I would not have had the resources to construct a testing fixture instrumental in evaluating, and now effectively treating, the prevalent and devastating condition of carpal tunnel syndrome."

- Ms. Gail Kulhavy, Staff Writer

## Air Force employs computer "hackers"

Ms. Debra Banning sends mischief and trouble in your direction every day, and the Air Force pays her to do it. She and her staff are "computer hackers" and they are very good at their work.

Ms. Banning spoke at the first Information Assurance Symposium at AFMC headquarters in June, which brought together both military and civilian leadership and technicians to work Information Assurance, IA, issues such as virus protection, cyber attack and security procedures.

"The very thing that gives the information age its power is also a weakness...its openness," said Lt. Gen. Charles Coolidge, Jr., AFMC vice commander. "We must provide security, but it must be tailored for the users, streamlined and transparent."

"IA is the effort to protect and defend our information and information systems from any form of degradation, to include intentional attack," said Ms. Banning, who works for the defense contractor Booz, Allen and Hamilton. In these simulated attacks, the "hacker" team is trying to help plug holes in Air Force information networks exploited by hackers.

"There is only one computer system we evaluate that we cannot get into. All of the others...we own." she said.

As the "I-love-you" bug and its relatives have shown recently, cyber attacks can be effective and costly. Damage estimates for this latest round of viruses is over \$10 billion. Security experts for the Defense Department have identified 11 separate foreign state-run programs that target U.S. government computer systems.

According to the Air Force Computer Emergency Response Team, cyber attacks occur every day. They handled more than 3,700 incidents in 1997. By 1999, this number more than doubled to over 9,000 incidents.

"This is only a percentage of the actual number of attempts, only the ones we see, said Banning. "The number of incidents in 2000 is projected to be more than 17,000."

Air Force officials at all levels agree information is a critical component of the battlefield. In times past, decision making might take days, weeks or months due to the speed at which the information to make those decisions traveled. Today, it is very close to a continuous information flow which necessitates a continuous decision making process.

Security programs and procedures are the basic tools used to combat these intrusions. Senior leadership is aware many people disregard these procedures because they are inconvenient. "Some of the procedures we must use to safeguard our information are difficult to perform," said Ms Benning. But all it takes is one individual to take the "easy shortcut" and it puts the whole system at risk from cyber attack.

"If an enemy can degrade our ability to process information and communicate by attacking our infrastructure or our information, we will be at a great disadvantage. And this could mean loss of lives," said Ms. Banning.

"Information assurance is critical to implementing the Defense Department view of the future, as portrayed in Joint Vision 2020," said retired Air Force Vice Chief of Staff, Gen. Thomas S. Moorman, Jr. "Not only do we want information assurance, we are seeking information dominance."

This effort requires everyone to do their part in keeping computer networks, information and systems secure, said Ms. Banning. And it's not always going to be easy.

Serious threats to systems are not only external but internal as well. There are security measures in place to defeat many of the more basic attack strategies, however users seem to find these procedures "difficult" and ignore them.

Simple things such as password protection, using anti-virus software, or opening suspicious email attachments are ignored, and have caused great problems in the past.

"No single solution will give us information assurance," said Ms. Banning. "This effort requires a defense in depth. We need to employ a multitude of security mechanisms, at different levels in the enterprise to protect against a wide range of attack scenarios. IA is only achieved through a balance of technology, people and operational procedures."

This is the challenge, said Ms. Banning. "Computer system users must learn the policies and procedures needed to protect this resource from exploitation by our enemies. We must use the procedures we have to provide for a continuous decision-making ability."

Remember, Ms. Banning's crew is on our side. But there are others out there...

- Maj. Harry Edwards, AFMC Public Affairs

#### Centralized network control center stands-up at Wright-Patterson

Wright-Patterson Air Force Base, Ohio, now has a centralized network control center, established to centralize the management, information protection operations and support functions for all base computer and network communications.

"The base CNCC will manage, support and protect all base level networks in accordance with Air Force guidance and AFMC standard levels of service and performance measures," said Lt. Gen. Robert F. Raggio, Aeronautical Systems Center commander.

Planning began almost one year ago when Gen. Raggio and Col. Ed Murphy, 88th Communications Group commander, asked AFMC for more than \$4 million to stand up the control center. "That requirement included providing our customers the most secure, robust metropolitan area network possible," Gen. Raggio said.

The Air Force must organize its limited communications and information resources to match force management and deployment practices. This has to be done while supporting the combat force structure.

One capability of the centralized network center is to protect the base network from viruses and intrusions. It will have access to every friendly device connected to the network and detect devices that might cause harm to the network. It allows the CNCC to turn devices on or off as needed, especially during high threat conditions and intrusion alerts.

The centralized network control center has the ability to troubleshoot customers' computer problems from the consolidated help desk. Before the stand-up of the new network center, Wright-Patterson had as many as three computer help desks providing services. Now, in accordance with Air Force guidance and network service level agreements with base organizations, the CNCC will provide a single customer service help desk for all of Wright-Patterson.

— Maj. Bennie Seawright, 88th Communications Group

## Airman's desire to serve exceeds his personal injury

ith the "What's in it for me?" attitude second nature to many nowadays, it wouldn't be unexpected for Airman First Class Brian Coles to cut his losses and walk away ... on his one leg.

Instead, he is fighting for permission to stay in the Air Force and fulfill what he calls his destiny.

A first-term airman working in the 76th Communications Squadron, he was involved in an industrial accident Jan. 21 that resulted in his right leg being amputated below-the-knee. Now he's waiting to find out if he'll lose his career as well.

#### All he ever wanted

Airman Coles has been around the Air Force his entire life. His father is retired from the Air Force, and both his brothers are active-duty Air Force. "It's all I know and all I want." he said.

"The Air Force has always been my future," Airman Coles said. "I've known since I was a little boy that I would one day wear a uniform like my dad's. It's everything to me, and I'll do anything to continue wearing it."

That desire to wear America's blue suit was evident in everything about Airman Coles, especially his personal appearance. In fact, the airmen who work with him nicknamed him "Pretty Boy Jenkins." he said. "He holds himself to a higher standard."

#### Getting his life back to normal

Assuming he'll be allowed to continue serving his country, Airman Coles began the physical therapy necessary to get back to life as "normal" as possible. He works out at least four times a week at a Lackland AFB, Texas, gym where he does the exercises and weight lifting his doctor prescribed.

That exercise is beefing up his strength and confidence. He said coming to terms with losing his leg has been easier than he thought and knowing he'll be getting a better prosthetic, designed specifically for him, that will allow him to walk again without crutches helps him cope.

#### What's important

"Everything happens for a reason, and I think God used this to open my eyes to what is really important in life," he said. "Before the accident, my wife and I fought a lot about little things that weren't really important. The accident

"The Air Force has always been my future...I've known since I was a little boy that I would one day wear a uniform..."

Airman Coles

#### **Sharp trooper**

"Everyone here has a nickname — it's always 'Something' Jenkins. We called him pretty boy because his boots were always shiny and his uniforms always looked good," said Senior Airman Brian Talbot, a fellow worker. "Now we're going to name him Flamingo, because they're pretty birds, graceful and usually stand on one leg."

Airman Talbot said that in their daily routine of digging trenches, working in the mud, down in manholes and up on phone poles people in his unit get dirty. He said most airmen in his unit are satisfied with their boots as long as they're "just a little black."

"But Airman Coles always looks good, like he's going to an inspection,"

brought us closer together. It was like God showed us how much we do need each other and that we're meant to be."

Airman Coles' wife, Desiree, and their son, Xavier, have been his biggest fans. Desiree is always lending words of encouragement and the strength he needs to keep going.

And Xavier has been there to cheer dad on while he learns to walk again with a new leg. "When I first got my leg," Airman Coles said, never once referring to it as a prosthetic, "Xavier was so happy, he'd say, 'Daddy is walking. Be careful daddy, be careful.""

It seemed that the toddler was as proud of his father's first wobbly steps as the father had been of the toddler's.



Push me higher! Airman First Class Brian Coles pushes his son Xavier on a swing outside his apartment where the two play each day.

Airman Coles, who could have lost his life in the accident, says he's happy to be alive and thankful for the support of his family and his extended military family. But now he's ready to get back to work.

#### This is my career

He's been manning a desk for about three months, waiting to find out if he'll be allowed to stay in the Air Force. According to his wife, he's been waiting to find out since he went into surgery.

"Before Brian went into surgery, he said, 'Desiree, this is my career,'" she said. "When he came out, he didn't know they had taken his leg.

"He looked at me and asked what had happened to it. I didn't know what to say to him. I was trying to be strong, trying not to cry and hoping he'd know by the look on my face so I wouldn't have to tell him."

He did know, by looking into his wife's eyes, that he'd lost his leg. He

cried "a little," and his wife waited for him to break down emotionally. For months after the accident she continued to wait for the depression to set in, but it never did.

"I didn't think he could handle this," she explained. "He was always so athletic, so self conscious about his appearance that I didn't think he'd be able to deal with this."

#### Focusing on the future

But he did. Together the Coles' have made a pact to focus on the present and the positives.

"Brian does get discouraged occasionally, and so do I," his wife said. "But I keep telling him he'll be able to do all the things he did before the accident, just as well as he used to do them."

And that's just what he's done. Airman Coles has exceeded his doctor's expectations every time he's been given a challenge. He's meeting his own personal goals and, equally important to him, he's meeting his career goals.

"I enjoy working in the office — don't get me wrong. Just like everything I do, I give it 110 percent. But I miss my job," he said. "I want to continue learning and get back in the field doing my real job."

So after a physical to determine what he is currently capable of doing, doctors decided to let him back out there with his crew. He knows he won't be digging trenches anytime soon, which is what he was doing when he lost his leg. But Airman Coles says he's happy just standing on the sidelines, learning.

And that he must be doing in grand fashion because Airman Coles' squadron recently selected the 21-year-old airman to compete for Senior Airman below-the-zone at base level.

"Airman Coles may have been off

duty for eight weeks after the accident, but he used the time well. He studied constantly and is even about to get his five-level qualifications," said Master Sgt. Pete Henderson, 76th CS first sergeant. "He is the best airman in our squadron to compete for BTZ."

In addition to studying for promotion and job training Airman Coles also learning how to do the things he used too, just a little differently. He's learned to shower while balancing on one leg, play table tennis and get around short distances.

#### One step at a time

With the aid of his prosthetic, he's learned how to carry Xavier, how to bench press weights, how to do most of his job requirements and, to the excitement of himself and his wife, how to dance again.

"We went to a wedding a couple of weeks ago and I watched the people dancing to Tejano music," Airman Coles said. "I missed it. Desiree and I used to dance a lot, so that next week we practiced at home."

The following week, the young couple was tearing up the floor to a Tejano beat at a friend's debut. Still, Airman Coles is trying to take everything one step at a time.

#### **Short term goals**

Setting short-term goals for himself keeps him focused on his long-term goal of walking with out a limp.

"I've never been in a wheelchair," he said. "I walked out of the hospital on crutches and was determined to be walking without them in a couple of months. Now I want to walk without a limp.

He encountered a few setbacks at first; the wound refused to heal properly

and became infected. But as soon as he could be fitted for his first prosthetic, he was

The first day with it on, he walked without help and the first thing he did was pick up his son, something he'd missed being able to do. Soon he'll be fitted for a personalized prosthetic that fits him better and will allow him to do more.

#### Awaiting his destiny

He can currently walk without crutches, but he carries one with him to "help with the stairs." And he climbs a lot of stairs nowadays. Each one takes him closer to finding out the fate of his Air Force career.

A medical evaluation board reviewed his case in July, and passed him to a physical evaluation board for a final decision.

The PEB is a fact-finding body that investigates the nature, origin, degree of impairment and permanence of the physical condition of any member whose case it evaluates. Their reveiw process will take from two to six weeks.

In hopes of helping the outcome, Airman Cole's doctor recommended to the board that he be allowed to stay in the Air Force.

"I see people with lesser injuries who don't do as well as Airman Coles has with his recovery, and I think he can stay on active duty. There are already set precedents," his doctor said.

"Airman Coles can run a marathon if he wants to. He is highly motivated. I tell most patients it will take about one year before they're back to normal. I think he will be there in only six months."

The doctor also said Airman Coles could pass most physicals without doctors knowing he had a prosthetic, unless he showed them.

But the only thing he has been showing anyone lately is how to overcome adversity. Whether he's on the job or on the dance floor he's getting back in the swing of things.

And according to Airman Coles, the board can take as long as it needs to make its decision, because every day the verdict's out is one more day he's in uniform.

— Ms. Karen Edge, SA-ALC Public Affairs

Ms. Desiree
Coles reads to
son Xavier, 2,
while Airman
Brian Coles
checks out the
story line. The
family tries to
spend as much
quality time as
possible
together in the
hopes of
returning to life
as usual.

Editor's note: It was recently announced Airman Coles won his below the zone promotion. He will be pinning on his third stripe on Sept. 18.

#### **Awards**

#### George Washington University honors two AFRL scientists

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Two Air Force Research Laboratory scientists were recently selected as winners of George Washington University's 51st Annual Arthur S. Flemming Awards.

Dr. Michael Berman, a senior program manager, Directorate of Chemistry and Life Sciences, Air Force Office of Scientific Research, Arlington, Va., and Dr. Steven Huybrechts, chief, Center for Spacecraft Component Technology, Space Vehicles Directorate were honored "for performing outstanding and meritorious work for the federal government."

Dr. Berman was recognized for his contributions to molecular dynamics and theoretical chemistry, which is involved in the study of chemical reaction dynamics and energy transfer. He was also singled out for his ability to quickly transition research advances in the areas of rocket propellants, aircraft and spacecraft signatures and surveillance, chemical lasers, and new materials.

Dr. Huybrechts was recognized for his contributions to space structure development, which involves integrating advanced composite materials into launch vehicle and spacecraft structures, and for his efforts to reduce the cost and enhance the future capability, survivability and usefulness of future launch and space systems.

— Mr. Timothy Anderl, AFRL contractor

## Edwards range boss earns \$10,000 NASA award

EDWARDS AIR FORCE BASE, Calif. — Mr. Steve Cronk, chief of the range safety office received a national-level award and \$10,000 from Daniel Goldin, NASA's administrator.

Mr. Cronk received the 1999 Government Quality and Safety Achievement Recognition Award.

"It's probably the highlight of my career," he said.

NASA's Dryden Flight Research Center here nominated Mr. Cronk for strongly advocating an alliance between the Air Force Flight Test Center and Dryden.

"We work closely with NASA and their range safety office, but we have

gone a step further," said Mr. Cronk. "It's a joint safety office because of the number of projects we have. We work closely, share our expertise and have a good relationship with Dryden."

NASA's unmanned aerial vehicle and reusable launch vehicle programs have been using AFFTC airspace and facilities.

Mr. Cronk's idea of an alliance has saved resources at both agencies by combining their strengths to meet the range and public safety challenges posed by UAV operations.

NASA officials also said that if it were not for Mr. Cronk and his safety office's timely risk assessment and formulation of alternative procedures for the X-33 program, NASA might have been forced to find another launch site at a cost of more than \$30 million.

— Maj. Dennis Mehring, AFFTC Public Affairs

## Contracting personnel win Air Force recognition

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — AFMC Directorate of Contracting personnel received eight awards at the Air Force level Contracting and Competition awards. The award recipients are:

Maj. Agustin Velez, Detachment 1 Air Force Research Laboratory, Wright-Patterson AFB, Ohio, won the Outstanding Officer in Contracting (Systems, Logistics, or Science & Technology) Award.

Maj. Velez oversaw the award of 425 contract actions valued at \$34 million. He also directed the \$10 million source selection for low-observable maintenance of radar absorbing materials, maximizing competition and attracting 100 potential offerors to industry conferences and receiving 49 proposals.

Ms. Dorothy Priest, Electronic Systems Center, Standard Systems Group, Maxwell AFB-Gunter Annex, Ala., won the Outstanding Civilian in Contracting (Specialized) Award.

Ms. Priest masterminded the Information Technology Tool Team's acquisition strategy that revolutionized the way the Air Force acquires information technology products. Her innovative strategy will save the Air Force \$50 million each year on hardware products alone and will reduce the contracting timeline to 30 days.

Ms. Donna Hairston-Benford, San Antonio ALC, Kelly AFB, Texas, won the Outstanding Civilian in Contracting (Systems, Logistics, or Science & Technology) Award.

Despite an unyielding workload and drastic personnel cuts in her branch, Ms. Hairston-Benford produced quality and timely products to support her customers, including the award of 10 competitive contingency contracts for Base Realignment and Closure workload transfers and the \$62 million F-15 Aircraft Mounted Accessory Drive Repair contract.

Ms. Jewel Burgess, Air Armament Center, Eglin AFB, Fla., won the Outstanding Purchasing Specialist Award.

Ms. Burgess provided outstanding support to her customers. She reduced her contract lead-time to an average of eight days and awarded a Global Positioning system contract in just two days in support of Operation Allied Force.

Maj. Nathan White, Detachment 8 Air Force Research Laboratory, Kirtland AFB, N.M., won the Special Recognition Award.

Maj. White pioneered a new A-76 acquisition approach that provided true "best value" dividends for the Air Force through partnering with the contractor. The award substantially aided two economically disadvantaged Native American tribes while meeting the Air Force's small disadvantaged business contracting goals.

The Joint Direct Attack Munitions Contracting Division at Eglin won the Outstanding Contracting Unit (Systems, Logistics, or Science and Technology) Award.

The contracting division worked around the clock to award JDAM weapons contracts to support warfighters during Operation Allied Force. In addition to their support of Operation Allied Force, they awarded 45 contracting actions valued at over \$98 million with an average lead-time of only 26 days.

Aeronautical Systems Center, 311th Human Systems Wing, Operational Contracting Division, Brooks AFB, Texas, tied for first place of the Javits-Wagner-O'Day President's Committee Award.

This unit opened a window of opportunity for the National Industries for the Blind and the National Industries for the Severely Handicapped.

The U-2 Contractor Field Service

Representative Team, Warner Robins ALC, Robins AFB, Ga., won the Outstanding Team Contribution to Competition and Commercial Practice Award.

This team implemented acquisition strategy to move the contract from a cost type, sole source to a competitive fixed price contract and consolidated ten separate contracts into one, producing initial savings to the Air Force of \$8

- Ms. Elaine Smith, PK directorate

#### SECAF honors AFRL **Small Business Office** director

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — The Director of the Air Force Research Laboratory Small Business Office was recently selected as a recipient of the Secretary of the Air Force's Special Achievement Award.

Ms. Patricia Deschaine was honored for her "expertise, professionalism and dedication to the Air Force Small Business Program," as part of the fiscal year 1999 Secretary of the Air Force Small and Disadvantaged Business

Ms. Deschaine was recognized as having worked both as a small business specialist within Aeronautical Systems Center and as the director of small business at headquarters AFRL.

One of Ms. Deschaine's successes

was when she convinced ASC to set aside two contracts for small business in the procurement of training systems. In all, five contracts were let under this multiple ordering eight-year contract, the estimated value of which is \$486 million.

Ms. Deschaine reviewed and assisted in the negotiation of several comprehensive subcontracting plans, and served as a focal point for industry and the Defense Department in answering questions about the program.

Ms. Deschaine routinely provided assistance to large businesses in identifying small businesses that were capable of meeting subcontracting requirements.

She also wrote to over 250 womenowned businesses, encouraging them to participate in acquisitions and advising them of resources available in assisting them to obtain contracts.

Secretary F. Whitten Peters presented Ms. Deschaine her award during a ceremony at the Pentagon, June 19.

— Mr. Timothy Anderl, AFRL contractor

#### Best in the business: Top Supply/Fuels officer

ROBINS AIR FORCE BASE, Ga. -Capt. John R. Lapore, chief of supply readiness and plans for the C-5 Management Directorate, was recently recognized as the Air Force's outstanding supply and fuels officer of 1999. He received the award in Washington D.C. July 13.

U.S. Air Force headquarters gives the award each year to supply and fuels personnel selected as the "best of the best." These awards provide Air Forcewide recognition of personnel who have made outstanding contributions to improving supply or fuels operations.

Capt. Lapore had a "huge impact" on the supply effort in Operation Allied Force, said Col. Thomas J. Owen, C-5 system program director.

"He developed, wrote and directed supply concepts; identified all supply personnel and equipment requirements for 25 U.S. and NATO deployed locations...orchestrated the transfer of more than 74 mobility readiness spares packages...supported 563 combat and mobility aircraft, combat communications equipment and air control squadrons," said Col. Owen.

Capt. Lapore instituted procedures for moving critical parts directly to customers, cutting average delivery time by 22 percent.

In the first weeks of the conflict, he masterminded creation of U.S. Air Force Europe's Aircraft Readiness Center to monitor and expedite movement of deliveries. Within 30 days, he reduced backorders by 28 percent and improved the mission capable rate from 79 to 90 percent.

He also masterminded the closure of USAFE's base service stores and tool issue centers while ensuring uninterrupted customer support.

— Mr. Hal McKenzie, WR-ALC Public **Affairs** 

#### Robins electrician wins DOD award

ROBINS AIR FORCE BASE, Ga. — Mr. Larry Keith Hamilton, a C-5 aircraft electrician, received the Department of Defense's Value Engineering Award 2000 in a ceremony held May 2 at the Pentagon.

Mr. Hamilton won the award for designing a test device for the C-5 anti-skid system that will save the taxpayer an estimated \$26 million a

Mr. Hamilton, a journeyman aircraft electrician, designed and built a test device that allows a mechanic to check the connectors, wires and voltages peculiar to the anti-skid system.

The test box, approved for use in the spring of 1999, is now employed throughout the directorate.

"In the original design on the C-5, there are 25 sets of brakes operating in pairs. The output of each one is critical for it to work," he said. "Before, we had no way to test the output of the sensors on each one."

Mr. Hamilton's device compares one set of brakes with the other to ensure that they are working properly together.

Since the directorate began using the box, not a single tire has blown, reducing functional test cycle time as well as producing a much safer aircraft.

Air Mobility Command, primary user of the C-5, estimates it spent \$53 million in fiscal year 1999 troubleshooting and repairing the anti-skid system. Use of Hamilton's test box is estimated to cut that cost in half.

— Mr. Hal McKenzie, WR-ALC Public **Affairs** 



Mr. Larry Keith Hamilton holds the test device fhe designed for the C-5.